A Scoreboard Based Method for Goal events Detecting in Football Videos

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***Abstract*—we provide a new method to detect goals in football videos in this paper. We found that there is usually a scoreboard in almost all the football game broadcast on TV and the score part of the scoreboard demonstrates the goals in the match intuitively. So by means of detecting the change of the score part, we could detect the goal events without much training data and the structural analyzing of the game videos. Our method is mainly based on the accurate location of the scoreboard and it includes three parts: locating the scoreboard from the frame images, extracting the score part of the scoreboard, and detecting the goals using the score part. At last we use the videos of European Champion League 2010-2011 to test our method and get some preferable results.**

Keywords-football video; scoreboard ;goal; frame difference

I. INTRODUCTION

In recent years, more and more football game videos are available because of the development of the TV broadcasting technology. Football has wide viewership and huge commercial potential [1], [2].A problem comes with it. Persons sometimes are more interested in the goals rather than the whole football game. The time of a football game is usually ninety minutes while the goal event commonly happens instantaneously. So the detecting technology based on content is getting increasingly attention in recent years. This technology can help people to watch football videos much better and to make TV station produce football collections more conveniently.

Many researchers are working in this domain. Some existent ways are as fellows: making use of the proceeding and pause events to detecting goals [3], detecting the appearance of the gate, using HMM models to detecting goals and so on. But there are some shortages in these methods. Only using the proceeding and pause events will regard some other scenes as goal because many other events such as foul or offside will all lead to pause. Detecting the gate could be easily affected by the advertising signs and the audiences in white clothes. The HMM models need huge mount of training data [4], but it is usually difficult to obtain so much data. While most of the research in sports video processing assumes a temporal decomposition of video into structural units such as shot or scene [5], [6]. This is extra loan for auto detecting.

According to the above information, we design a method taking advantage of the scoreboard to detect the goals. It is common that the scoreboard will change as soon as a goal event happens, so it is the most intuitive indicator of a goal event. Our method detects goal event by monitoring the variation of the scoreboard, so it can work effectively with low complexity while not much training data are need. Our method also need not to analyses the structure of the video. What is more, our method could reduce the disturbance from players, referees and other factors.

II. THE WAY TO LOCATE THE SCOREBOARD

In a football video, there is always a scoreboard on the right or left upper corner of the frame picture. The scoreboard regularly includes the names of the two teams, the remaining time and the score and we only need the score part because the score part indicates the goal event directly. In order to locate the score part we should locate the scoreboard first.

The left image of Fig. 1 is a gray image from a football video and the right image of Fig. 1 is the border image obtained after using Sobel operator [7]. We could find that the rows of the scoreboard contain more border information than the field and audience areas via immediate observation. In the border image the light value of pix at the border is much higher than those pix in other area. So we could use the number of the pix whose light value is larger enough in a row or column as criteria for scoreboard. So we design algorithm to locate score part as fellows.

Step1: Transform the original colorful frame image into gray image.

Step2: Detecting the border using Sobel operator.

Step3: Determining which row is “score row”. First we use a counter to record the number N_i of the pix whose light value is larger than some threshold T_1 for every row i. Then we check out the number N_i, if $N_i > width \times T_2$, in which T_2 is some threshold and $width$ is the width of the frame image, whose unit is pix, we regard the correspond row i as a “score row”

Step4: Determining the top row and bottom row of the scoreboard. Because the scoreboard is usually on the upper of the image, we start from upper to lower. If the number of the continuous “score row” is larger than some threshold T_3, we can regard the start and end of the continuous score rows as a group of top row and bottom row of the scoreboard.

Step5: Determining which column is “score column”. For every group of top row and bottom row, we scan every column between them to record the number N_j of pix whose

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light value is larger than some threshold T_4 in column j. If $N_j > (bottom - top) \times T_5$, T_5 is some threshold, we regard the correspond line j as a "score column".

Step6: Determining the left column and right column of the scoreboard. Because the scoreboard is either on the left or on the right of the image, we select only one side according to the match videos. If the number of the continuous "score column" is larger than some threshold T_6, we can regard the start and end of the continuous score line as a group of left column and right column of the scoreboard.

Step7: Determining the score part of the scoreboard. Finishing the above six steps we get some groups of border for the scoreboard. To diminishing interference we wipe off those smaller ones so we can get the final scoreboard. In order to locate the score part, we need some priori knowledge. The score part is normally at the center of the whole scoreboard and not longer than the whole scoreboard's eighth. We calculate the coordinates of score part by the fellow formula.

$$x_1 = (left + right)/2 - (right - left)/8. \quad (1)$$

$$y_1 = top. \quad (2)$$

$$x_2 = (left + right)/2 + (right - left)/8. \quad (3)$$

$$y_2 = bottom. \quad (4)$$

(x_1, y_1) is the upper-left corner of the score part and (x_2, y_2) is the lower right corner of that.

III. THE WAY TO DETECT GOAL

It is a common knowledge that the score part of the scoreboard will not change at all while it will change suddenly when a goal event happens. And hence the difference image of the score parts coming from the consecutive two frames is almost an all-zero image until a goal happens. So we could use the number of the non-zero pix as criteria to detect goal event. Our algorithm is as fellows.

Step1: We denote $f(x_i, y_i)$ as the frame i, so we can calculate the frame difference using (5) frame by frame. Notice that we only calculate the score part obtained by the previous section.

$$diff = f(x_i, y_i) - f(x_{i-1}, y_{i-1}). \quad (5)$$

Step2: Then we count the number N_i of the non-zero elements of the frame difference.

Step3: If $N_i > T_7$, T_7 is some threshold, we regard a goal event happens at the frame i.

Considering the goal event will not happen twice in frequent intervals, two or more goal events whose time interval is shorter than some threshold T_8 are all thought as one goal.

IV. EXPERIMENT RESULTS

At first, we use about ten match videos of the European Champion League 2010-2011 to train our threshold mentioned part II and part III. After that we choose four matches of the same series to test our method. All these videos are broadcasted by China Central Television Channel 5 (CCTV-5) and China Central Television Football Channel (CCTV-Football).The size of these videos are all 612×460 and their frame rate are 25fps. We divide this videos into the first half and the second half.

TABLE I. EXPERIMENT MATCH FOR OUR METHOD

No.	Name
1	Internazionale VS Tottenham Hotspur
2	Barcelona VS Copenhagen
3	Real Madrid VS AC Milan
4	Bursaspor VS Manchester United

A. The result of locating scoreboard.

Fig.2 demonstrates the results of locating scoreboard. The yellow rectangle on the figures denotes the score part. We can see that there are some parts which are not of the score part inside the yellow rectangle, but it is not important because these parts will hardly change during the whole match, so it will not affect the accuracy of our method. From these pictures we can see that out method could precisely find the target location.

B. The results of detecting goal events

We use our method to process the above four videos in Table I and get the result displaying in the Table II. We divide these videos into two halves and discard those ones in which no goal event happens. We use recall ratio and precision ratio to evaluate our method.

From the table we can see that our method has a very high recall ratio. It is nearly 95.8%. Precision ratio is lower, average 75%. It is because some specific scenes will affect the score part such as the TV station's clock, the playing the match logo as a transition or the unexpected disappearance of the scoreboard. These specific frames are shown in Fig. 3 and Fig. 4. These kinds of interference could be reduced by means of calculating the ratio of the main color and detecting the appearance of the gate.

TABLE II. EXPERIMENT MATCH FOR OUR METHOD

Match	Total Goals	Found Goals	Recall Ratio	Precision Ratio
1 First Half	4	3	75%	100%
1 Second Half	3	4	100%	75%

Match	Total Goals	Found Goals	Recall Ratio	Precision Ratio
2 First Half	1	2	100%	50%
2 Second Half	1	2	100%	50%
3 First Half	2	2	100%	100%
4 Second Half	3	4	100%	75%

V. CONCLUSION

In this paper we have presented a new method based on the score part of scoreboard of a football video to detect goal events of the game. Because of the close tie between a goal event and the change of the score part, the method has a very high recall ratio. Although many thresholds are needed for the whole detecting process, but it needs not so much training data as those are needed by using HMM. And the method needs not to divide videos into shot, scene and so on. So our method can works effectively with a low complexity.

The method performs not very well considering the interference coming from the TV station's clock, the match logo and sometimes the white advertising signs and the field audience in white clothes. While the method don't perform well in terms of the precision ratio, we think the transient unexpected signal interrupt in football broadcasting may lead to low precision ratio. Because this may make the whole image turn black suddenly and disturbing our method. So the next work includes diminishing the interference mentioned above and working to seek out those frames suddenly turning black.

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REFERENCES

[1] A.Kokaram, N.Rea, R. Dahyot, M. Tekalp, P.Boutheny, P.Gros and I. Sezan, "Brossing sports video: trends in sports-related indexing and retrieval work,On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," IEEE Signal Processing Magazine, vol. 23, no.2, pp.47-58, 2006.

[2] M. Kolekar, K. Palaniappan, "A hierarchical framework for semantic scene classification in soccer sports video," First Future Internet Symposium,pp.191,2008.

[3] A.Ekin, M.Tekalp, "Generic event detecting in sports video using cinematic features," IEEE Workshop on Event Mining: Detection and Recognition of Events in Video,pp.17-24,2003.

[4] Wang Jinjin,Xu Changsheng, Chen e, "Sports highlight detection from keyword sequences using HMM," Proceedings of International conference on Multimedia and Expo, IEEE Press,2004, 1 pp.599-602.

[5] V. Chasanis, A. Likas, N. Galatsanos, "Scene detecting in videos using shot clustering and yymbolic sequence segmentation," IEEE Workshop on Multimedia Signal Process,pp. 187-190,2007.

[6] C. Ngo, T. Pong, H. Zhang, "On clustering and retrieval of video shots through temporal slices analysis," IEEE Transaction on Multimedia, vol.4,no.4, pp.446-458, 2002.

[7] G.Bradski, A. Kaehler, Learning Opencv 1st ed, vol. 6. Beijing: O'Relly,2009, pp165-170.

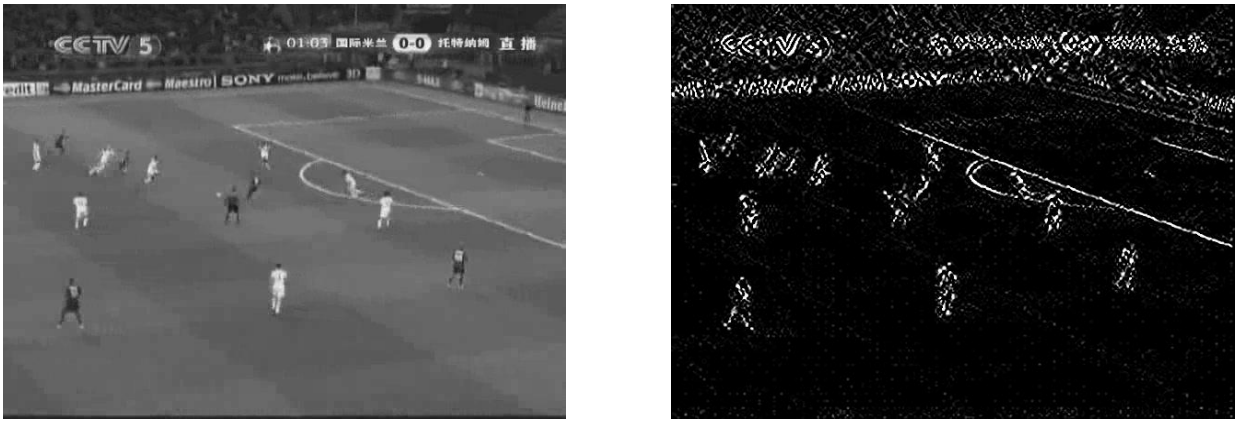
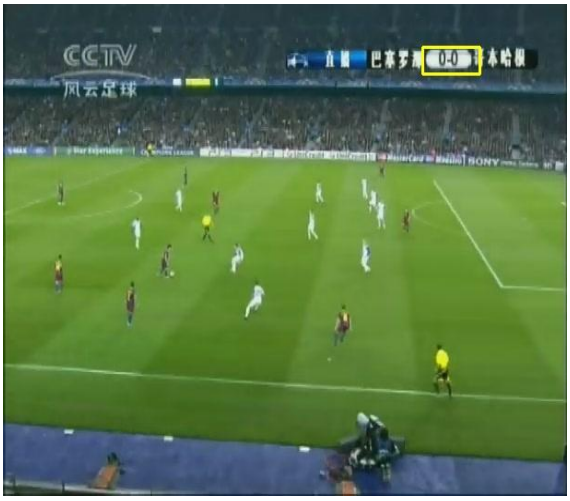


Figure 1. Example of the gray image and the border image using Sobel operator.



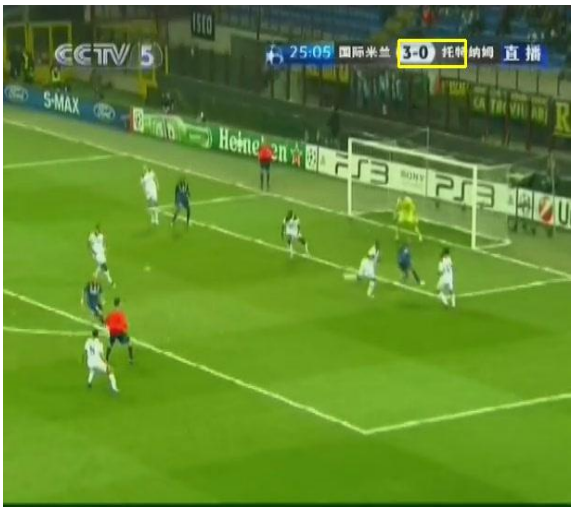


Figure 2. The results of the location of the score part of scoreboard.

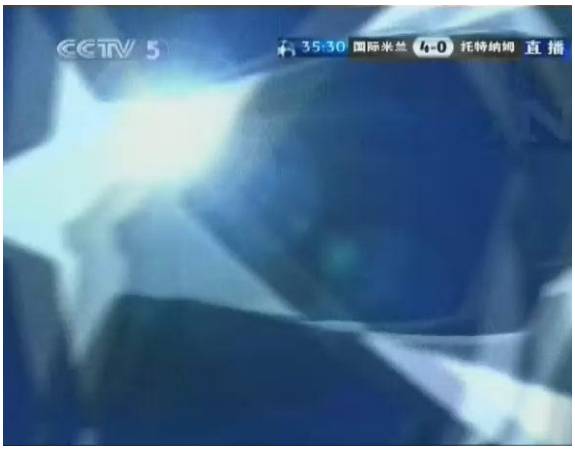


Figure 3. Example of the match logo disturbing the scoreboard

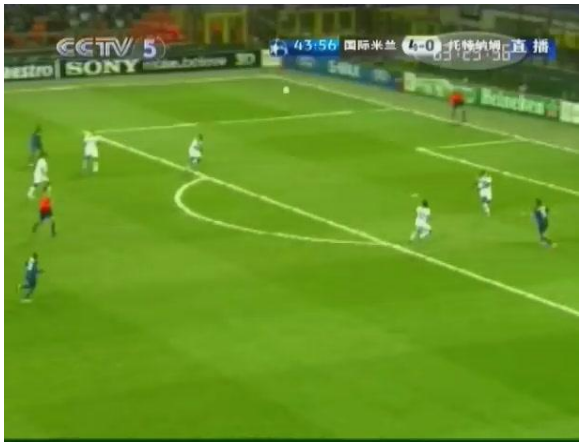


Figure 4. Example of the TV station's clock disturbing the scoreboard